PATENT COOPERATION TREATY

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INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 1.V474.12PC.2	**FOR FURTHER ACTION** See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/IB 03/05852	International filing date *(day/month/year)* 09.12.2003	Priority date *(day/month/year)* 17.12.2002
International Patent Classification (IPC) or both national classification and IPC H04N7/30		
Applicant VISIOWAVE S.A. ET AL.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 7 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 5 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the opinion
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - VI ☐ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

Date of submission of the demand 04.05.2004	Date of completion of this report 10.05.2005
Name and mailing address of the international preliminary examining authority: European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016	Authorized Officer Lombardi, G Telephone No. +31 70 340-4329

I. Basis of the report

1. With regard to the **elements** of the international application *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17))*:

Description, Pages

2-12, 14-16	as originally filed
13	received on 08.11.2004 with letter of 04.11.2004
1, 1a	received on 11.03.2005 with letter of 08.03.2005

Claims, Numbers

1-4	received on 11.03.2005 with letter of 08.03.2005

Drawings, Sheets

1/5-5/5	as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

   These elements were available or furnished to this Authority in the following language: , which is:

   ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
   ☐ the language of publication of the international application (under Rule 48.3(b)).
   ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

   ☐ contained in the international application in written form.
   ☐ filed together with the international application in computer readable form.
   ☐ furnished subsequently to this Authority in written form.
   ☐ furnished subsequently to this Authority in computer readable form.
   ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
   ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

   ☐ the description, pages:
   ☐ the claims, Nos.:
   ☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

   (Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	2-4
	No:	Claims	1
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1-4
Industrial applicability (IA)	Yes:	Claims	1-4
	No:	Claims	

2. Citations and explanations

   see separate sheet

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

The following documents, cited in the international search report, are referred to in this international preliminary examination report:

D1: EP-A-0 866 426 (ALSTHOM CGE ALCATEL) 23 September 1998 (1998-09-23);

D2: MALLAT S ET AL: 'ANALYSIS OF LOW BIT RATE IMAGE TRANSFORM CODING' IEEE TRANSACTIONS ON SIGNAL PROCESSING, IEEE, INC. NEW YORK, US, vol. 46, no. 4, 1 April 1998 (1998-04-01), pages 1027-1042, XP000779819 ISSN: 1053-587X;

D3: CHANDRA S ET AL: "JPEG compression metric as a quality aware image transcoding" 2ND USENIX SYMPOSIUM ON INTERNET TECHNOLOGIES AND SYSTEMS, PROCEEDINGS OF USENIX'99: 2ND SYMPOSIUM ON INTERNET TECHNOLOGIES AND SYSTEMS, BOULDER, CO, USA, 11-14 OCT. 1999, pages 81-92, XP002249728 1999, Berkeley, CA, USA, USENIX Assoc, USA.

1. The present application does not satisfy the requirements of the Article 6 PCT, because the subject-matter of several claims is not clear in the sense of Article 6 PCT. This lack of clarity nothwithstanding, the present application does not satisfy the criterions set forth in Article 33(1) PCT because the subject matter of the claims is not new (Article 33(2) with Rule 64(1) to (3) PCT) or does not involve an inventive step (Article 33(3) with Rule 65(1) and (2) PCT).

1.1 The subject-matter of claim 1 is not clear in the sense of Article 6 PCT. Indeed, the subject-matter of claim 1 includes the feature that the Mean Square Error MSE is computed by the formula given in claim 1, line 18, "for the case of uniform quantization" (claim 1, lines 16-20).

That implies that <u>all</u> the "Spatial Video CODECs" (claim 1, line 1) may also employ non-uniform quantization and such possibility is disclosed by the description (page 8, line 26-page 9, line 7).

For the case of non-uniform quantization, no computational formula is defined in claim 1, thus making the claim unclear.

Therefore, the subject-matter of the claim shall be interpreted in broad sense, so that the parameter *MSE* and, by consequence, the parameter λ are left undefined in claim 1. Therefore, the claim will be interpreted for the purpose of this preliminary report by considering only its preamble (claim 1, lines 1-14).

1.2 This lack of clarity notwithstanding and by interpreting the claim as explained in paragraph 1.1, the subject matter of claim 1 is not new (Article 33(2) PCT).

Document D1 discloses (the references in parentheses applying to this document) a method of selecting among N "Spatial Video CODECs", where N is an integer number greater than 1 (page 5, lines 7-11; page 6, lines 35-39), the optimum "Spatial Video CODEC" for a same input signal I, characterized by the following steps:

obtaining from all the N "Spatial Video CODECs" for the same input signal I and a same quality parameter Q, the rate R and the distortion measures D, Q being an integer value between 0 and 100, defined by any rate-distortion algorithm to provide a compression of the input sequence with constant rate or with constant distortion (page 13, lines 5-8,13-14,35-36,40),

calculating an optimality criterion by using the value $L_n=f(R_n,D_n)$, calculated for all the n from 1 to N, n being the index of the "Spatial Video CODEC", where $f(R_n,D_n)$ is a function of R_n and D_n (page 13, lines 40-41,47-48: the optimality criterion consists in performing a maximization).

Thus, the subject-matter of claim 1 is not new (Article 33(2) PCT).

1.3 Dependent claims 2-4 do not appear to contain any features which, in combination with the features of any claim to which they refer, meet the requirements of Article 33(1) PCT in respect of inventive step in the sense of Article 33(3) PCT with Rule 65(1)-(2) PCT, because the additional features are either well known in the prior art or thereby rendered obvious as from the following:

Claim 2

The features added over the independent claim are standard design options.

Claim 3

Document D2 discloses at pages 1029-1037, paragraph III, that the estimate of the rate outputted by a spatial video encoder may be determined from the significant coefficients (equations (9) and (10) and related text) and that, for at least wavelet and JPEG encoding the rate may be approximated by the product of an experimentally determined constant and the number of significant coefficients (page 1034, left-hand column, second typographic paragraph of the text; page 1035, right-hand column, second typographic paragraph of the text).
The features added over the independent claim consist in the same approximation disclosed in document D2, so that the features added over the claim 1 are rendered obvious by the disclosure in document D2.

Claim 4

The features added over the independent claim are disclosed in document D2..

2. Claim 1 would have been new and involving an inventive step in the sense of Article 33 PCT, if a limitation to the case of Spatial Video CODECs, at least one of them using a uniform quantization, was introduced, as suggested by the originally filed claim 6.
In that case, the parameter *MSE* and, by consequence, the parameter λ would have been unambiguously determined for at least one Spatial Video CODEC by the formula given in claim 1, line 18.

Such determination by means of said formula for at least one Spatial Video CODEC is not disclosed or rendered obvious in any way from the prior art.

Indeed, only a general dependence of the type $MSE=\Delta^2/12=[f(Q)]^2/12$ is rendered obvious by the available prior art, which consists in the combination of document D2 (pages 1027-1028, paragraph II-A: the mean square error is well known to be given, as approximation, by the squared quantisation step divided by 12 for any encoder including uniform quantisation) and of document D3 (pages 83-84, paragraph 2.1, especially the formula for *S* and *imgQuantTbl[i]*: the quantisation step may be a function f(Q) of a percentual quality factor Q, as it happens in particular for JPEG, which is also a compression method cited in document D3).

2.1 Finally, it is necessary to observe that the description (cf. in particular page 8, line 26-page 9, line 18) does not disclose any embodiment, where the parameter *MSE* and, by consequence, the parameter λ are determined in the case of non-uniform quantization in a non obvious way (Article 33(3) PCT), having in mind the disclosure given by the avalaible prior art, given by the combination of document D2 and D3, mentioned in paragraph 2 above.

METHOD OF SELECTING AMONG "SPATIAL VIDEO CODECS" THE OPTIMUM CODEC FOR A SAME INPUT SIGNAL

The present invention relates to method of selecting among N "Spatial Video CODECs" where N is an integer number greater than 1, the optimum "Spatial Video CODEC" for a same input signal I, according to the following steps:- obtaining from all the N "Spatial Video CODECs" for the same input signal I and a same quality parameter Q, the rate R and the distortion measures D, Q being an integer value between 0 and 100, defined by any rate-distortion algorithm to provide a compression of the input sequence with constant rate or with constant distortion, calculating an optimality criterion by using the value $L_n=f(R_n,D_n)$ calculated for all the n from 1 to N, n being the index of the "Spatial Video CODEC", where $f(R_n,D_n)$ is a function of R_n and D_n. In this new technique (hereafter referred to as "Dynamic Coding") for digital video coding, "Spatial Video CODEC" is understood as the combination of any transform of the input signal, followed by a quantization of the transform coefficients and a corresponding entropic coder.

Video Coding is an important issue in all application fields where digital video information has to be stored on a digital support or transmitted over digital networks. Several solutions have been proposed in the last 20 years and standardizations efforts have been undertaken to define a unified syntax.

Standard video coding schemes have a rigid structure. They take into account the context of specific, well-defined applications requiring video coding, and propose an optimized, albeit limited, solution. This explains the number of existing international recommendations that have been defined for specific applications. For example, the ITU-T H.261 standard is designed for tele-conferencing and videotelephony applications, MPEG-1 for storage on CD-ROM, MPEG-2 for wideband TV broadcast, MPEG-4 for low-bitrate coding with multimedia functionalities and H264 for very low bit-rate video coding.

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1 a

The strategy adopted by classical video coding schemes is prompted by the fact that no a single universal coding technique can be applied with optimum results in every context. In fact, the performance of a "Spatial Video CODEC" depends on several application specific parameters, such as: the type of the data to be compressed (still pictures, video, stereo imagery, and so on), the nature of the visual

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CLAIMS

1. Method of selecting among N "Spatial Video CODECs" where N is an integer number greater than 1, the optimum "Spatial Video CODEC" for a same input signal I, according to the following steps:

- obtaining from all the N "Spatial Video CODECs" for the same input signal I and a same quality parameter Q, the rate R and the distortion measures D, Q being an integer value between 0 and 100, defined by any rate-distortion algorithm to provide a compression of the input sequence with constant rate or with constant distortion,

- calculating an optimality criterion by using the value $L_n=f(R_n,D_n)$ calculated for all the n from 1 to N, n being the index of the "Spatial Video CODEC", where $f(R_n,D_n)$ is a function of R_n and D_n,, characterized

in that the Spatial CODECs are aligned according to the theoretical MSE and the quality parameter Q, MSE being the Mean Square Error and is computed as $MSE=\frac{\Delta^2}{12}=\frac{\left(2^{(C_1-Q/C_2)}\right)^2}{12}$ for the case of uniform quantization with an average step Δ defined as $\Delta=2^{(C_1-Q/C_2)}$ where C_1 controls the minimal and maximal quality and C_2 the variation of the distortion according to quality parameter Q,

in that the optimality criterion is defined as the minimization said value $L_n=f(R_n,D_n)$,

in that the said function is defined as the Lagrange optimization $f(R_n,D_n)=R_n+\lambda D_n$,

in that he Lagrange multiplier that weights the relative influence of the rate R and of the distortion D is defined as $\lambda=\frac{1}{2\cdot\ln(2)\cdot MSE}$.

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2. Method according to claim 1, characterized in that the input signal I is a natural image or a predicted image or any rectangular sub-block from a minimum size of 2x2 of the natural image or of the predicted image.

3. Method according to one of the claims 1 to 2, characterized in that the rate R of the *n*-th "Spatial Video CODEC" is approximated by $R=\alpha(N_T-\sum_{x_i=0}^{|x_i|<\Delta} N_{x_i})$ where N_{xi} is the number of coefficients with an amplitude equal to x_i, N_T is the total number of coefficients and the parameter α is derived from experimental results.

4 Method according to one of the claims 1 to 3, characterized in that the distortion D of the *n*-th "Spatial Video CODEC" is approximated by

$D=\sum_{x_i=0}^{|x_i|<\Delta} x_i^2 N_{x_i}+\frac{\Delta^2}{12}\sum_{|x_i|\geq\Delta} N_{x_i}$ where x_i is the amplitude of the coefficients and N_{xi} is the number of coefficient with an amplitude of x_i.

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dure introduces a significant amount of computations that increase with the number N of evaluated "Spatial Video CODECs". In fact, in order to evaluate the distortion of a single "Spatial Video CODEC" it is necessary to scale back the quantized coefficients, to perform the inverse transform and to compute the distortion compared to the input. The rate is obtained first by performing the Entropic Coding of the quantized coefficients and then by counting the resulting bits.

In the preferred implementation, an approximate prediction of both R and D is obtained without the need of performing the Quantization, the Entropic Coder, the Scaling and the Inverse Transform steps. The prediction can be computed in a much more computationally efficient way and the introduced approximation does not affect the correct choice of the best "Spatial Video CODEC".

In the preferred implementation, the rate is estimated as a linear function of the number of zeros obtained after quantization of the coefficients while the distortion is approximated from the distribution of the transformed coefficients. In particular, before quantization, the histogram of the transform coefficient is computed. The rate is predicted as a function of the quantization step Δ:

$$R = \alpha\left(N_T - \sum_{x_i=0}^{|x_i|<\Delta} N_{x_i}\right) \qquad (12)$$

where N_{xi} is the number of coefficient with an amplitude equal to x_i, N_T is the total number of coefficients and the parameter α is derived from experimental results. Note that in a preferred implementation Δ is related to Q by equation (2), thus the rate is a simple function of the quality parameter Q defined by the rate-distortion algorithm.

The distortion is predicted from the distribution of the transformed coefficients: